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ABSTRACT

This report summarizes one of a series of workshops organized by RAND's Critical Technologies Institute, on behalf of the U.S. Department of Education, to take advantage of the experience of those already implementing new technologies in the schools. The workshop consisted chiefly of dialogues with educators and experts from the private sector who are working to apply emerging telecommunications systems for learning. This summary addresses questions on educational software development and serves as a primer on the market realities of the educational software business. Participants concluded that the market is weak for several reasons: schools have little money to spend on software; it was not always clear that educational materials dollars could be spent on instructional technology; manufacturers often shy away from the lengthy review processes and long-term commitments that many states require; and production values tend to be lower for school multimedia than for the more glamorized multimedia marketed for the home computer. In this regard, the advantages and disadvantages of the integrated learning system (ILS) are outlined. Besides being limited, the educational software market seems too unsettled to be accurately analyzed. The market is currently being driven by technological achievements for their own sake, but as people become more and more receptive to computers, the market will become propelled by consumer demand. In the meantime, school budgets for software remain: (1) controlled by only a few key figures; (2) too low; (3) tied to outmoded premises about learning; (4) concentrated on the elementary grades; and (5) subject to rising expectations placed on them by the visual sophistication of home "edutainment" software. An appendix lists the participants. (BEW)

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RAND

The Market for Educational Software

James Harvey (Editor)

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Critical Technologies Institute

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PREFACE

Urged on by both the President and Vice President, federal officials have been exploring how to encourage greater and more effective use of modern telecommunications and computer technologies in the nation's schools. In July 1994, RAND's Critical Technologies Institute (CTI) completed a broad investigation of educational technology for the Office of Science and Technology Policy and the National Science and Technology Council. This preliminary work examined the nature and level of federal efforts to assist educators and trainers and an assessment of major barriers to further progress.

On the basis of this preliminary investigation, the U.S. Department of Education asked CTI to assist the department as it responded to new provisions in the 1994 *GOALS 2000: Educate America Act*, provisions calling on the Secretary of Education to provide a plan for effective utilization of new technologies in the nation's classrooms. Initially sought by March 1995, the deadline for the plan was postponed by subsequent legislation until September of the same year.

This report summarizes the third of four workshops organized to take advantage of the experience and insights of those already implementing new technologies in the schools. The first workshop examined professional development needs. The second looked into planning for, and financing, technology. This third workshop, like the others, consisted of a one and one-half-day conversation with educators and experts from the private sector working to apply emerging telecommunications systems for learning. Appendix A lists the participants. The fourth workshop, on equity, is in the planning stages.

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THE MARKET FOR EDUCATIONAL SOFTWARE

Is it true that educational games have taken the consumer market by storm while similar technologies have scarcely made a dent in the nation's schools? Was the president of a major high-technology firm correct when he charged several years ago that schools are low-tech dinosaurs in a high-tech world? What are the differences between the home and school markets? How do we insure that technology does not increase the size of the gap between the education "haves" and "have-nots" in our society?

What, in brief, is the state of educational technology? In particular, what kind of market exists in the nation's schools for advanced educational software that is simultaneously a sophisticated tool for curriculum and learning and an advanced and compelling product in terms of the production values built into it?

These questions lay at the heart of this workshop as it struggled with the effort to understand the dynamics and trajectory of educational software development in the United States–how it has developed, where it stands today, and where it may be heading in the future.

This discussion provided a primer of sorts on market realities in the educational software business. This basal reader includes several elementary lessons.

The first is that the education software market is a mess. The economics of the school market do not work for software developers, for a variety of reasons. Schools spend very little on software. Schools continue to rely on traditional texts and the textbook market differs profoundly from the software market. Home "edutainment" materials do not always or readily translate to the classroom, although some crossover is evident.

Second, the existing school market for complex "integrated learning systems" (ILS) affiliated with special needs populations is static, not growing. This mainstay of educational technology, therefore, provides no incentive to encourage large-scale developers to invest in research and development–in fact, many are getting out of the business.

Finally, educators, policy makers, and software developers are shooting at a moving target from a moving platform. Most expect huge learning benefits from technology, but they are unsure how these technologies will develop. Many are worried that existing platforms, software and equipment are already out of date and, consequently, are cautious about significant additional investments until the path ahead is more fully illuminated.

At the same time, the real educational software market for the home appears to exist for relatively young children (aged three to ten) and then it disappears. Parents appear to be ambivalent about these emerging technologies. They want teachers to help them select software for home use, but understand that the teachers know no more than the parents. They want software that provides routine drill, but then appear to believe that drill is overdone in the school.

THE MARKET IS A MESS

Surely with nearly 50 million students enrolled in public and private schools nationwide and huge demand for adult and continuing education, a strong and vigorous market is ready-made for developers, distributors, and manufacturers of educational software? Such an assumption is hasty and ill-considered was the consensus of those attending the workshop. The school market for software is weak, according to participants. People who cannot understand that really do not comprehend how schools are organized, how they make purchasing decisions, and in particular the dynamics of school software purchases.

Start With the Numbers

Start first with the numbers, was the advice of the head of one small software development firm. "As soon as you start playing around with some of these figures in very rough round numbers you begin to see immediately what the problem is.

"We have about 50 millions students in 100,000 buildings. Annually about $5 billion is spent on something called 'educational materials,' or about $100 per pupil." According to this participant, half of that amount goes to textbooks, leaving perhaps $2.5 billion (about 1 percent of all education spending, or $50 per pupil) available for everything

else—films, filmstrips, maps, recordings, other materials, and computer software.

"At a very rough guess," he concluded, "I would put the general education software market at about $350 million—plus or minus 50 percent. Another $350 million, again plus or minus 50 percent, is spent on Integrated Learning Systems software under programs such as Chapter I.

"So we are spending perhaps $15 or $16 per student annually on education software." He argued that software developers can get close to $100 for a high quality home computer game—obviously a much more attractive market possibility. "Is one-quarter to one-third percent spending on software enough to stimulate improved supply? Obviously not. But how do you get to 10 percent? Because that is what it will take."

Think About the Purchasing System

A different set of numbers drives marketing decisions, said textbook publishing representatives. The federal government plays an important leadership and direction-setting role in K-12 education, but more than 90 percent of all education funding in K-12 comes from units of state and local government. Publishers, including software publishers, have to deal with state and local education agencies.

The school textbook market is divided into two categories, said one participant. What are known as "adoption states" are found South of the Mason-Dixon line and in California. These are states with statewide screening and approval processes for textbooks and education materials, most of which provide some state support for the acquisition of state-adopted materials. The marketing job here comes in two tiers: "At the state level, we obtain a hunting license to sell within the state. We then seek our sales from local districts."

States in the North and Midwest, by contrast, are for the most part "open adoption" states--publishers can seek sales directly district-by-district.

Until 1990, it was not clear that educational materials dollars could be spent on instructional technology. Traditional textbook

dollars, according to publications provided at the workshop by the Software Publishers Association, were implicitly reserved for print-based materials. Schools interested in technology relied on a variety of special funding sources: teachers' own funds, special local or state technology initiatives, or federal programs such as Chapter 1, Head Start, special education, Even Start, or Eisenhower grants.

All of that changed in 1990 when Texas provided the first statewide adoption of a technology-based instructional product. Many states have since rewritten their legislative codes to make it clear that software and electronic products are acceptable educational materials.

Even with a sale in hand, however, the dynamics of the educational materials market discriminate against software developers and manufacturers in several ways—not the least of which is that traditions and common practice continue to govern the purchase of educational materials.

Continuing Limitations

The first dynamic that must be understood, said one publisher, is that state and district requirements normally demand long-term contracts at fixed prices. Software manufacturers shy away from these requirements, convinced that hardware, systems, and software itself are changing too rapidly to make such a commitment.

Second, the review process is expensive. Adoption states frequently require sizable up-front application fees (as much as $5,000 per submission according to the Software Publishers Association). In addition, larger states may require every publisher to provide free access to multiple platforms (DOS, Macintosh, Apple IIe, etc.) in a score or more of service centers, plus one each per reviewer, for reviewing the software.

Finally, one of the benefits of statewide adoption is the effort to insure equity of pricing for every school within the state. But what sounds desirable in theory, turns out to be a marketing nightmare for software developers. Nobody thinks twice about spending $40 per student on a biology textbook, said one participant--and that price can be equitable in a large urban district or a small rural one.

But in the world of software--basically a product licensed to schools so that all students can use it—the policy of equity pricing changes the equation dramatically. Five or ten students might use such a product (at a sales price of perhaps $500 or $600) in a small rural district. But in a large district, 100 students or more may have access to the product, for the same $500 or $600. "The analogy for a textbook publisher," said one participant, "would be the following: Individual textbooks could be sold only to the school library, not to each student."

When you add all of these factors up, said one publisher, it turns out "You can lose money in educational software, even if you corner 100 percent of the market!"

The larger lesson? In many ways, there are not 50 million potential customers in the schools, there are only about 100,000—that is to say, with licensed software, there are only as many potential customers as there are buildings. In fact, there are not even 100,000 potential customers since a software program aimed at high school algebra students obviously cannot be used in elementary or middle schools. "From our point of view," concluded one developer, "the educational materials market is really very fragmented."

Production Values

Nor can educators count on a large overflow of educational products from the home market. There is very little overlap between the two markets, according to participants. The home market for education materials appears to exist from ages three to ten, said one participant. Another echoed that view, adding that only four areas of potential crossover exist between the home and the school markets: reading; elementary arithmetic, particularly multiplication; drill and practice in algebra; and programs to help students prepare and do well on the Scholastic Aptitude Test (SAT).

But the bigger problem lies in the quality of the production values (animation, art, graphics, scripts, sound and music) available in the two markets. "Publishers by-and-large have been terrific content developers," said one publisher, "but we have been very poor multi-media

developers. Until recently, education software had a production quality about it that reminded me of television in the 1950s."

But if education software can be compared with 1950s television, home products have all the glamour and excitement of MTV. One series of interactive books for small children, said a participant, is made up of 16-page booklets--each developed by a team of some 50 people, including artists, musicians, animators, script-writers, computer scientists, programmers, and program managers. Each of these booklets, which has some intrinsic educational value, costs about $500,000 to develop, compared to approximately $25 million for a major textbook.

The larger lesson in all of this is that the market for software--either in the home or the school--is remarkably unforgiving, even treacherous. Just a year or two ago, said one participant, a consumer product might sit undisturbed on retailers' shelves for up to six months. "In effect, the product had six months to make an impression on the public--in large part because the retailer had no other software to crowd the shelves.

"Today, a new product has 30 days to make money in retail stores. If it does not perform within a month, it is dead."

ILS AND CATEGORICAL SUPPORT

Picking up on the comment that schools interested in technology relied until recently on special funding sources such as Chapter 1 to support Integrated Learning Systems (ILS), several participants discussed the prospects for these systems.

An ILS is a vertically and horizontally integrated system that cuts across grade levels and permits common management of different subjects for different students. All ILS's have as a common mission the improvement of learning, and management and assessment are linked to learning goals and the delivery of curriculum Finally, all ILS systems are marketed to administrators of states and localities--not to schools, to teachers, or to individual students.

At their best, according to one participant, ILS's are capable of spectacular learning results, but too often they are poorly used. They can be employed in four ways by teachers:

- Novice teachers often use an ILS systems as a babysitter;
- Experienced practitioners use the management and reporting features of these systems and begin to obtain educational results;
- "Integrating" teachers begin to design lessons using this tool and these teachers begin to achieve powerful results; and
- "Extenders" find new uses for ILS and often obtain "spectacular" learning results.

So these systems show significant promise, according to participants, but are unlikely to achieve their full promise. Revenue for ILSs have been flat or increasing on the order of 5-10 percent per year for the last three years, according to one workshop member, creating genuine problems. "At 5 to 10 percent levels of revenue increase, major developers do not invest in research and development or in new software. At those levels, developers concentrate on maintenance, renewal and on improving some of their tools.

"That is where we are now, and this is a problem in several ways. First, even absent major change, it is not healthy to have no new development or no new software. But we have a major new change--the standards movement and GOALS 2000." According to this participant, these new movements require schools to move from the old Chapter 1 approach (essentially tutorial) to the new emphases in Chapter 1 and GOALS 2000—developing higher order thinking skills.

That is a hard change to make in the best of times. But just at the very time when ILS systems most need attention, "half-a-dozen or more of the big players in the ILS market have just walked away from it, in part because it is impossible to improve the system in a period of flat revenue growth."

The result is that the "architecture" of ILS's as they now exist constitute a significant problem in themselves. New instructional approaches contemplated by new directions in the education reform movement require a new architecture, better tools, and new courseware. These emerging needs cannot be met until revenue again begins to grow.

A MOVING TARGET FROM A MOVING PLATFORM

Finally, the overwhelming sense to come out of this workshop was a belief that the market for educational technology has not yet settled down enough for most people to clearly understand where it is headed. Policymakers (and parents and educators) are aiming at a moving target from a moving platform.

The ILS discussion itself revealed participants' discomfort that schools are already saddled with systems that appeared to meet needs reasonably well as recently as five years ago, but now are out of date.

In addition, the "costs of tools and software for different platforms is substantial" said one participant. "Different platforms can add as much as 60 percent to costs if the software is to be able to be used simultaneously on DOS and Macintosh platforms. What we need are tools that will let software be 'spit out' on different platforms—and we can already do that in the home market with CD-ROMS.

"Another problem is that many of the platforms in schools are seriously outdated. We estimate that about 46 percent of DOS machines in schools are incapable of operating Windows. And we also find a lot of old Apple II's still floating around in schools, long after the rest of the world has forgotten these dinosaurs."

One representative from a major publishing house introduced the uncertainty by describing how his company is trying to position itself for the future: "We are not making money in software. We are not even sure what the break even point for us will be. A decade ago we invested about 3 percent of total product sales in technology. Today, we are trying to invest between 7 and 10 percent.

"Why are we willing to double or triple our investment when we know that right now this is not a profitable line for us? Because we are trying to get ready for this market when it shifts and takes off. The issue for us is not if it will shift, but when it will shift. At some time, this new technology will overnight become as ubiquitous as the fax--one day it is not there, and the next day it is everywhere. If we are not ready for that, then we are out of business."

The information superhighway in the form of Internet may be the best example of how rapidly things are changing and are likely to

change. Internet has grown from nothing into 30 to 40 million users, worldwide, in a matter of years.

But the Internet of today bears little resemblance to what will be available tomorrow, according to several participants. Today's Internet, as exciting as it seems, has limited capacity, poor security, little ability to discriminate and find meaningful information, difficult navigation procedures, and is frequently crowded at its most popular points. In brief, the infrastructure of the system is well in place, but the system itself has yet to come of age.

Within the next twelve months, according to one attendee, several of these problems will be solved--people will be able to gain access to the system much more easily and use it with far fewer difficulties.

In fact, according to a major Find/SVP survey of Home Educational Content and Technology Usage described at the workshop, the uncertainty in the education market mirrors the larger uncertainties as the larger society. Technology, according to the managers of this survey, is in the midst of a transition. Today, technological change is being driven by the development of the technologies themselves. Within a very short time, consumer needs, interests, and demands will drive technology markets and technological change. This transformation is likely to be completed by the turn of the century as technologies mature--and more and more citizens use new technologies and become more comfortable with the digital revolution.

According to the results of this survey:

- Education in the home takes place in the context of information overload-both parents and children have limited time.
- Parents are willing to make remarkable financial sacrifices to purchase personal computers for their children-which are used mostly for edutainment and skills software for younger children, and games and utility functions (e.g., word processing) for older children. Very few households (around 5 percent) have children or adults on-line.
- Consumer information spending, like education, rises with income and is surprisingly constant by age.

- Most people complain about common challenges in gaining access to, and using, information: too much effort (20%); wrong form (35%); little value (44%); not useful enough (56%); can't find it (58%) and it costs too much (74%).
- In 1994, homes were much more likely to have cam-corders, personal computers, and video games, than they were other technologies. In American homes, for example, only 4 percent reported having a CD-ROM; 5 percent a stand-alone fax; 6 percent a notebook pc;13 percent a modem; and 15 percent a cellular telephone. More than one-quarter of homes report having cam-corders, pc's, or video games.

But the speed of change in public attitiudes toward technology is revealed by the fact that while maybe only one-tenth of all households use personal computers at home in any significant way, the "installed base" for home CD-ROM usage is growing by leaps and bounds. In 1993, it is estimated that there were about two million CD-ROMS; a figure that jumped to seven million by 1994 and is expected to nearly double again in 1995.

Interest in every conceivable interactive service is very high in American households: e.g., movies and television on demand, educational content, interactive games, electronic banking, thermostat control, health care monitoring, electronic encyclopedias, monitoring utilities, and electronic shopping.

Nonetheless these interests change dramatically for different kinds of families:

- About 18 percent of families (known as either "learn and play families," "information strivers," or "high brow achievers") own most of the home personal computers.
- "Low brow" families (32%), "information laggards" (33%), and "mainstream middle brow" (18%) have almost no computers.
- All families that own computers appear to be trading television time for PC time. Low brow families spend an average of five hours *per user* on a computer and about 17 hours *per person*

watching TV. High brow families nearly match TV viewing and PC use on a *per person* basis, with computer users averaging about 11 hours per week and TV viewers averaging about 12 hours per week.

Against that backdrop, Find/SVP focus groups indicate that parents are confused about what kinds of software to purchase off the shelf—and they report that teachers cannot help them. Most parents are also worried about a number of other issues. They do not fully understand where their children are in terms of education needs. They worry about home-school compatibility of the software they purchase. They do not want more skills, voicing the thought that students get "enough of that at school." And they do not know what to do with old software as children move on to the next level. (At the same time, according to a workshop participant, software manufacturers are "terrified" of releasing education software for the home market without a drill and practice component because manufacturers are convinced parents will insist on it.)

Children for their part report enjoying personal computers because they can interact with them. Moreover, younger children learn from a wide variety of different kinds of software, including edutainment and believe that any learning can be entertaining—it does not always have to be adventurous or fun.

The major conclusions, according to the FIND/SVP Survey: Educational use of the computer at home is significant but restricted to "early adopters," or the highly educated and motivated. Parents are confused about software value and worried about on-line services. The major educational software gap exists for middle and high school students. Schools do not appear to be a strong influence with respect to home educational software purchase decisions. And, interest in new electronic interactive services appears to cross demographic groups.

IMPLICATIONS

First, the K-12 software market is shaped by several institutional realities. Key acquisition decisions are sometimes controlled by a

small number of actors (often a state body for many schools and school districts). Traditions and practice inherited from print-based educational materials are slowly changing, but continue to dominate. A significant proportion of computer hardware in schools is obsolete by today's standards both restricting the appeal of the school market and shaping school demand in ways that are unattractive for private sector software developers.

Second, at $15 or $16 per student annually, school budgets for software are low. Vendor revenues are quickly eaten up by the costs of development, preparing different run-time versions of the software for different school computer platforms, maintaining inventory and delivering the product. Too little remains for product improvement and innovation.

Third, the important ILS segment of the school market is stagnant and built on outmoded premises about learning. New concepts of instructional management to match emerging educational reform goals are needed.

Fourth, the school market for occasional-use supplemental software is limited largely to the elementary grades. Participants were unanimous in agreeing that high-quality content software for the middle and secondary school grades was practically non-existent.

Fifth, home market revenue for high-production-value "edutainment" software bids fair to overtake revenue for educationally correct, but low-production-value school software, in two to three years. The visibly more sophisticated product may set a new standard of parental expectation for the quality of school software, creating a new demand on the school budget for a higher-priced, educationally correct and visually sophisticated software product.

Sixth, the trend towards image-enriched, visually more sophisticated educational software would be accelerated by the successful entry of "Hollywood-based" firms or subsidiaries like Lucas and Disney into the educational software market.

In summary, the structure of school budgets, which requires that educational technology be acquired from the vanishingly small fraction of the budget that remains after all other requirements are met, a

current emphasis in the schools on Internet service that tends to emphasize hardware acquisition, and an expanding home market for "edutainment" imagery in CD-ROM format combine to create an uncertain school market for an increasingly sophisticated educational software industry.

Appendix

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